RECOGNIZING RELATIONSHIPS OF MULTIPLE STREAM CAPTURE POINTS ON THE COLORADO RIVER AND ITS TRIBUTARIES IN ARIZONA

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The modern, integrated Colorado River system in Arizona, has most likely formed by a process of headward erosion into preexisting drainage configurations (Blackwelder, 1934; McKee and others, 1967; Hunt, 1969; Lucchitta, 1989). A polyphase history for the system is generally accepted by most geologists, who recognize that a regional, northeast-directed drainage system was established throughout much of central and northern Arizona, after final withdrawal of the Late Cretaceous Interior Seaway. Lucchitta (1989) suggested that these early Tertiary systems, contained second order tributaries, formed in strike valleys beneath retreating scarps or cuestas, that were aligned perpendicular to the general northeast flow. These northwest-southeast trending cuestas and strike valleys, formed as Mesozoic-age strata was progressively stripped off of Laramide-age folds, mostly to the northeast and away from the core of the uplifted Central Arizona Highlands. A trellis pattern of drainage may have existed in early Tertiary time in various parts of Arizona.

This system gradually evolved from northeast-directed primary streams, and their right-angle northwest-southeast tributaries, into the general southwest-directed drainage pattern seen today (Scarborough, 1989. This drainage reversal was most likely initiated by the changing tectonic regime in central Arizona, known as the mid-Tertiary Orogeny (Spencer and Reynolds, 1989). This extensional event caused the collapse of the Central Arizona Highlands, and may have initiated northeast, headward erosion across the recently lowered terrain. Drainage reversal may have included ponding in some segments of the old northwest-southeast aligned drainage. This means that later headward erosion might have breached some closed, interior-drained basins, as well as through-going rivers. The present work suggests that points of stream capture, or basin breaching, for six ancient, northwest-southeast aligned drainages, is preserved in certain sections of the modern Colorado River and its tributaries.

In each of the six case studies, the captured segment of the drainage or basin, trends to the northwest-southeast and flow directions on the modern streams within it, approach and oppose one another (Figure 1). Each northwest-southeast alignment is contained on its southwest side by a barrier formed of steep, fault-bounded(?) mountain scarps. The outlet direction of the capturing stem always flows to the southwest, through this barrier. The consistent similarities between the six, triangular stream configurations is astounding, considering the distances that separate them (Figure 1). Three of these examples are located on the main branch of the Colorado, and three others are found on its major tributaries in Arizona.

The first example is located on the lower Colorado River, at its junction with the Bill Williams River near Parker Dam (Figure 1A). The lower stem of the Colorado River is at a right angle to the aligned, but opposing flows of the Bill Williams River and upper part of the Colorado. The Whipple and Buckskin mountains form the southwest trending barrier that the lower Colorado River may have breached to capture this stream. The suspected capture point is the sharp, right angle bend of the Colorado near Parker Dam. Example two is from the central part of the Grand

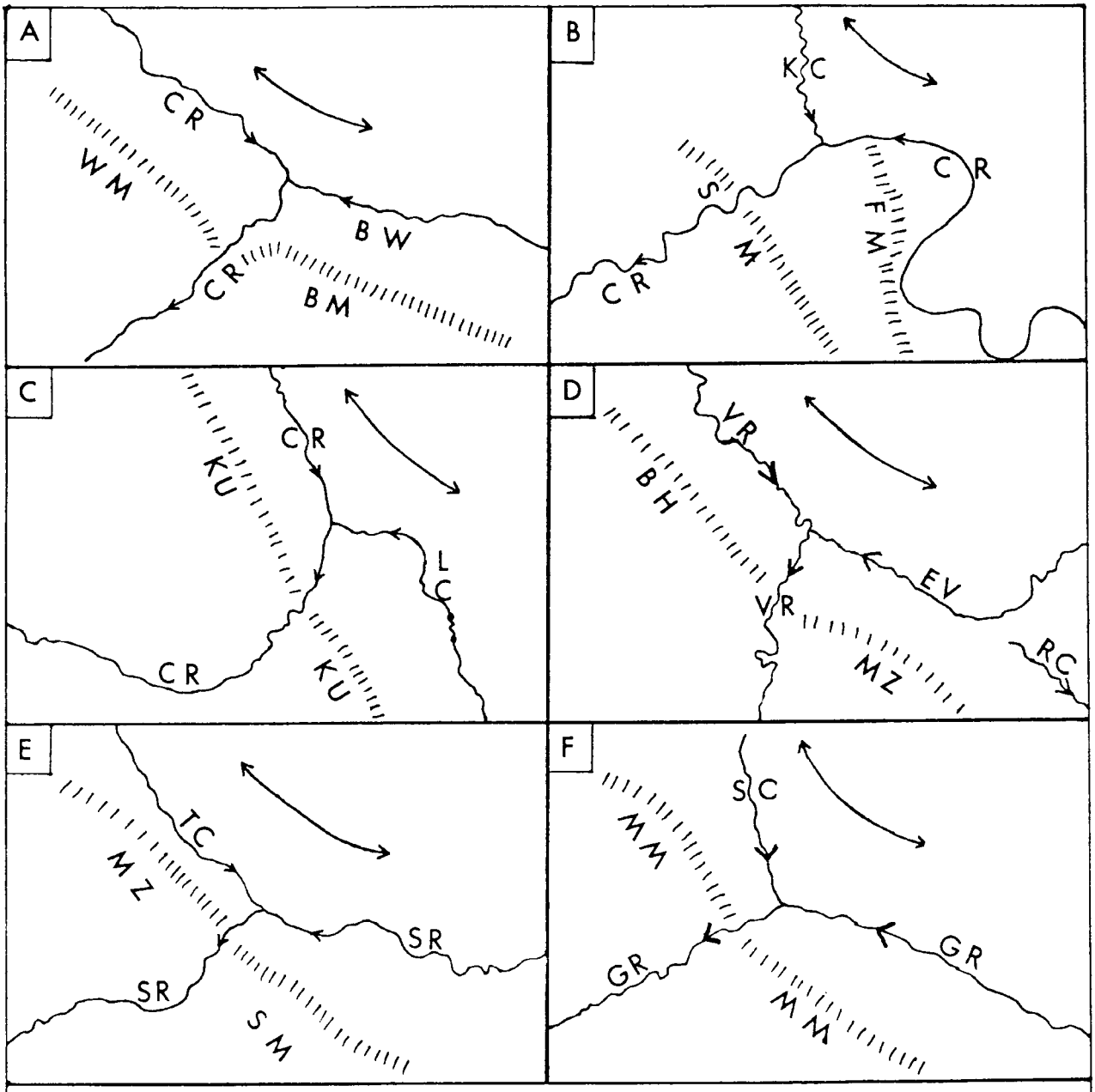

FIGURE 1. Six locations on the modern Colorado River (CR) system where southwest-flowing stems breach topographic barriers and intersect northwest-southeast trending stems and tributaries. Possible stream capture points are shown as triangular intersections at the center of each figure. Arrows drawn on rivers show the modern flow direction. Double-sided arrows show the pre-capture stream or basin axis. Scale = 1:500,000. North is up.

A. Lower CR - Parker Dam. WM=Whipple Mts., BM=Buckskin Mts., BW=Bill Williams River.
B. Central Grand Canyon. SM=Supai Monocline, FM=Fossil Monocline, KC=Kanab Creek.
C. Eastern Grand Canyon. KU=Kaibab Upwarp, LC= Little Colorado River.
D. Verde River (VR). BH=Black Hills, MZ=Mazatzal Mts., EV=E. Verde River, RC=Rye Creek.
E. Salt River (SR). MZ=Mazatzal Mts., SM=Superstition Mts., TC=Tonto Creek.
F. Gila River (GR). MM=Mescal Mts., SC=San Carlos River.

Canyon near Kanab Creek (Figure 1B). Here the southwest-directed stem is the meandering Colorado River in the Muav Gorge, and the northwest-southeast aligned "pre-capture" stream is the combined Kanab Creek and upper Colorado reaches. The barrier was possibly the now eroded scarps of Mesozoic strata that most likely were being stripped away to the southwest off of the Muav Fault/Crazy Jug Monocline. The last example on the Colorado River is also located in Grand Canyon and is found near the confluence with the Little Colorado River (Figure 1C). The confining barrier in this instance is the Butte Fault/East Kaibab Monocline. Northeast of it, the flows of the Colorado and Little Colorado rivers are now towards one another, and the lower stem of the Colorado River trends southwest away from them.

The last three case studies contain one proposed capture point on each of the three major tributaries of the Colorado River in Arizona, the Verde, the Salt, and the Gila rivers. All three examples are in line with each other across central Arizona, suggesting a regional, ancestral relationship. On the Verde River, the northwest-southeast aligned paleodrainage is composed of the upper portion of the Verde, and the East Verde River, and is bounded on its southwest side by the Black Hills and the Mazatzal Mountains (Figure 1D). Rye Creek may be a dismembered section of this old drainage, which continues on strike to the southeast towards the fifth example, where Tonto Creek and the Salt River merge at Roosevelt Dam (Figure 1E). The lower Salt River breaches the Mazatzal and Superstition mountains, in apparent capture of this drainage. Still in line with this configuration is the last example, located on the Gila River, at its juncture with San Carlos River. The lower Gila River breaches the Mescal Mountains to form this triangular relationship. Because of the perfect alignment of portions of these three Colorado River tributaries, it is suggested they may have formed a regional system of stream trends, that were emplaced southwest of the mid- Tertiary Mogollon Rim. Late Miocene(?) stream capture from lower Colorado River tributaries may have breached and destroyed these northwest-trending basins.

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